Hydraulics and Hydrology Guidelines for use in preparation of submittals to Department of Natural Resources – Division of Water for review of dams and improvements to dams

The following guidelines, along with the General Guidelines for New Dams and Improvements to Existing Dams (1999), are recommended for use in preparing the hydraulic and hydrologic analyses of dams for review by the Indiana Department of Natural Resources Division of Water. If an existing USACE Phase 1 report or other approved study is available, some of the following data may already be available for use. Detailed documentation of data taken from existing studies will not be required if the study is already on file in our office. The term "Professional Engineer" as used in this document is defined as an engineer that is licensed to practice in Indiana under IC 25-31.

Spillway, Energy Dissipater, and Dam Height Considerations

a) If design of the primary and/or emergency spillway system is to be completed to safely pass the required design storm, a Professional Engineer's certification must be provided to show that the selected spillway configuration(s) can safely withstand the hydraulic pressures and discharge velocities that may result from the selected design storm discharge.

b) If design of the spillway outlet structure is to be completed to safely convey the selected design storm discharge, and to prevent damage to the spillway outlet structure and downstream dam embankment, energy dissipation calculations must be provided to show where the hydraulic jump will occur, and the resulting discharge velocities exiting the energy dissipation structure. A Professional Engineer's certification must be provided to show that the selected energy dissipation structure can safely withstand the hydraulic pressures and discharge velocities that may result from the selected energy dissipation design.

c) For dams where embankment overtopping is not a consideration, the dam embankment elevation should be designed so that appropriate freeboard is provided between the top-of-dam elevation and the routed design storm.

Hydraulic and Hydrologic Analyses

a) If watershed characteristics, including drainage area, runoff coefficients, and watershed time of concentrations must be developed, supporting information and calculations showing how the watershed characteristics were developed must be provided for review.

b) If rainfall depth(s), duration, and distribution for the project design storm(s) must be determined and reservoir inflow hydrograph(s) for the selected design storm(s) are developed, supporting information and calculations showing the rainfall distribution, how the distribution was applied, and how the resulting inflow hydrographs were developed must be provided for review.

c) The stage-storage curve for the reservoir should be determined to an elevation that is at least higher than the final designed top of dam elevation. Supporting calculations showing how the stage-storage curve was developed must be provided.

d) When primary and emergency spillway stage-discharge rating curves are developed for use in flood routing analyses, supporting calculations and methodology showing how the rating curve(s) were developed must be provided for review.

e) HEC-1 or HEC-HMS is the preferred software package to use to develop the inflow hydrograph(s) and perform flood routing calculations for the reservoir. A print out of the final design flood routing must be provided.

f) Downstream backwater calculations should be developed for a sufficient distance downstream to establish tailwater control conditions for use in analyzing and designing the energy dissipation structure, and to determine resulting flood elevations and stream and overbank flow velocities. The backwater modeling must conform with the "General Guidelines for the Hydrologic-Hydraulic Assessment of Floodplains in Indiana "

g) HEC-RAS (preferred) or HEC-2 should be used to develop flood profile elevations for downstream and tailwater control calculations. Plots of cross sections, including information showing limits of effective flow areas (if applicable) should be provided for review. Cross section locations should be shown on mapping or drawings of sufficient detail to determine the hydraulic and geometric relationships between adjacent sections. Supporting information showing how channel, left, and right overbank roughness coefficients (Manning's "n" values) were determined must be provided. Output tables from the backwater calculations should be provided. The backwater modeling must conform with the "General Guidelines for the Hydrologic-Hydraulic Assessment of Floodplains in Indiana "

Submittal Information

a) Copies of the watershed characteristics (drainage area, runoff coefficients, time of concentration, etc.), stage-storage curve, design storm(s) (rainfall depth durations, distribution, etc.) and the design inflow hydrograph must be provided to the DNR for review and concurrence.

b) A final design report should be prepared containing the design parameters and narrative describing the hydrology and hydraulics for the selected final design. The report should include tables and graphics showing the design rainfall depths and rainfall distribution, final design watershed characteristics (drainage area, time of concentration, runoff characteristics), as well as plots of the final design stage-storage curve, stage-discharge curve(s), inflow hydrograph, and routed outflow hydrograph. A Professional Engineer must certify that the energy dissipation structure has been properly designed.

c) Final models in electronic format must be provided. Electronic copies of spreadsheets and other input data and/or supporting calculations used to develop the final design must be provided.

d) The design and construction drawings must be sealed by a Professional Engineer. The construction drawings must include standard details and engineering specifications, and must be provided to DNR for review.